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SEVERE WEATHER CLIMATOLOGY (1950-1994)

FOR THE NEW NWSFO JACKSON, MISSISSIPPI,

COUNTY/PARISH WARNING AND FORECAST AREA

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1. Introduction

As part of the Modernization and Associated Restructuring of the National Weather Service, several offices across the United States have seen significant operational change over the past few years. The Jackson, Mississippi, National Weather Service Forecast Office has also seen considerable changes in its area of forecast and warning responsibility, many coming in just the past year (1995). This new area of responsibility now crosses state boundaries,with the assumption of nine parishes in Louisiana and two counties in Arkansas (Fig. 1).

A local study of severe weather climatology was commissioned in the fall of 1995 encompassing the new, modernized forecast and warning area. The following study documents the new county warning area severe weather climatology including tornadoes, severe thunderstorms (convective high winds and hail), the effects from nearby tropical cyclones, and flash flooding. The primary data source was taken from the Severe Plot software (Hart 1993) provided by the Storm Prediction Center (formerly the National Severe Storms Forecast Center) for the period 1950 through 1993. Monthly issues of the *Storm Data* publication were also used as a supplement for the period 1959 through 1994.

2. Preliminary Considerations

Population Distribution

The population density for the counties/parishes varies greatly across the whole county warning area (CWA). Overall, the population ranges from 1,909 people in Issaquena County, Mississippi, to 254,441 people in nearby Hinds County, Mississippi (Fig. 2). The greatest population concentration is obviously associated with the metropolitan area centered around Jackson, with other peaks around the cities of Meridian (Lauderdale County), Hattiesburg (Forrest County), Vicksburg (Warren County), and Greenville (Washington County).

Geographical Considerations

The new CWA/forecast area does not encompass large geographical changes within its boundaries. The western edge of the CWA includes the Mississippi River Delta region (Mississippi Alluvial Plain), which is flat, level land (generally 80 to 110 ft msl), much of which is devoted to intensive soybean and cotton cultivation (Fig. 3). The tree population across this region is sparse. Just to the east of the Alluvial Plain, across the Mississippi River, are the Bluff Hills which extend from near Natchez northeastward to the Tennessee state line. East of the Bluff Hills are the Pine Hills across the southern tier of counties and the North Central Hills which begin to the north of the Jackson Prairies. Much of the CWA is situated in the Pine Hills Region, which has dense populations of coniferous trees (with the exception of the Jackson

Prairies, which consist of open patches of grassland interspersed with woodland areas, both coniferous and deciduous).

One will find little elevation change with distance across the western areas of the CWA. The exceptions to this are along the Bluff Hills which see very quick changes on the east side of the Mississippi River (such as around Vicksburg and Natchez). Heights in this region quickly go from 80 ft msl west of the river to around 250 ft msl just east of the river. Eastern parts of the CWA consist of small rolling hills (most notable around Meridian) with average elevations ranging from 300 ft msl to around 500 ft msl (Cross, et al. 1974 and U.S. Dept of Commerce 1982).

Severe Weather Distribution

As one would expect, because public reports are integral to the verification of severe weather, the overall severe weather distribution across the CWA varies in direct proportion with the population distribution. For the purposes of this study, we calculated the total number of severe weather days for the period 1959 through 1994 (Fig. 4). A severe weather day is defined as a calendar day in which at least one severe weather event was reported (i.e., three severe weather reports during a single calendar day counts as one severe weather day). The severe weather days were extracted through detailed inspection of *Storm Data* for the period (1959-1994).

For the total period, the highest numbers of reported severe weather days were in or near the population centers or along major highway systems. Note in Fig. 4 the elevated values from Madison Parish, Louisiana, east to Lauderdale County, Mississippi, along the Highway 80/Interstate 20 corridor.

Emphasis on verification of severe weather increased in about 1980. We broke the severe weather days down into two eras—pre-verification (1959-1979) and post-verification (1980-1994). In the 21-year pre-verification era (Fig. 5), the total number of severe weather days were significantly lower than those found for the same areas during the 15-year post-verification era (Fig. 6). The relative maximum near Jackson is obvious in both eras. It is not likely that severe weather was less frequent in the 1960s and the 1970s in comparison to the 1980s and early 1990s. This simply shows that there was a more concerted effort by the NWS and other agencies to investigate severe weather after 1979 as new technology came on line. Also, in the period after 1979, an increased effort was placed on spotter training and local storm verification. This could explain such radically different values when comparing sections of northeast Louisiana and east-central Mississippi in the two eras. Statistics provided by the Severe Plot program also show this trend (Fig. 7) when looking at the total number of reported events, and not just severe weather days, from 1980 through 1993.

Figure 8 illustrates the distribution of total severe weather reports by month for the period 1950 through 1993, indicating the spring severe weather peak to be in April. A secondary severe weather season occurs in November. Figure 9 illustrates our findings of total severe weather reports by hour. The highest frequency of occurrence was around 6 p.m. LST. Most severe weather was reported between the hours of 1 p.m. and 10 p.m. The time of the lowest reported occurrence was in the early morning hours around 5 a.m.

2. Tornado Climatology

The number of tornadoes across the Jackson CWA has varied widely over the 43-year period 1950 through 1993 (Fig. 10). The period 1950-1965 shows a roller coaster appearance. During this period, individual small tornadoes (especially those in outlying areas) may have gone unreported. The larger tornadoes generally were reported due to the greater likelihood of damage, injury or death. Whether or not the tornado passed near a population center could also have played a role in whether it was reported—or at least detected.

Climatology shows the 1970s as being an active decade across the Jackson CWA, averaging 27 tornadoes per year. The 1980s averaged nearly as many, with 24 tornadoes per year. The reader should note that by the start of the 1980s, improved communications were in place among the NWS, civil defense, law enforcement, and the news media in detecting and reporting tornadoes. Also, better public understanding of severe weather, storm structure, and spotter training may have helped in this process.

Also noticeable is a high incidence of tornadoes in 1992. The next closest year was 41 reports in 1971. The higher 1992 number is due to Hurricane Andrew (in late August), along with a major outbreak of tornadoes that struck the United States from East Texas, across the southeastern states and into North Carolina on November 21-23 (U.S. Dept. of Commerce 1993a).

Tornado reports by month (Fig. 11) show an active late winter and early spring season across the CWA. This season peaks in April, with 176 reports. Also, there is a late fall season, with a peak of 133 reports in November.

Reports by hour (Fig. 12) show a maximum occurrence between 3 p.m. and 7 p.m. LST. About 400 (40% of all reported tornadoes) occurred during this five-hour period. There is also somewhat of a secondary maximum between 7 a.m. and 10 a.m., during which about 139% of the reported tornadoes occurred. The outbreak of November 21-23, 1992, alone resulted in a third maximum showing up in the data, between 12 a.m. and 2 a.m. LST.

Figure 13 shows that most (71%) of the reports have been in the F1-F2 (moderate to considerable damage) categories (Fujita 1987). This is a significant finding! Overall, 48% of the reports were in the light to moderate damage category (F0-F1), 44% were in the considerable to severe damage category (F2-F3), while only 7% were in the devastating to incredible damage (F4-F5) category.

The number of tornado-related deaths by year (Fig. 14) varies greatly, with maxima in 1953, 1966, 1969 and 1971. The most noticeable maximum is 118 deaths in 1971, associated with an outbreak in the Mississippi Delta region on February 21. Since 1971, the number of deaths per year across the CWA has been relatively low. A noticeable exception was the ten deaths associated with the Brandon, Mississippi, tornado in November 1992. A reported total of 326 individuals lost their lives as a direct result of tornadoes in the CWA between 1950 and 1993 (most occurring prior to 1972).

The number of deaths by month (Fig. 15) shows a maximum in February. The Delta Outbreak of 1971 accounted for 86% of the total for February. Also, there have been more than 40 deaths in December and January. The number of injuries by month (Fig. 16) also shows a maximum occurrence in February, which is again heavily weighted by the Delta Outbreak. In comparison to February, the month of March has a higher number of reported injuries, nearly 900.

When examined in relation to time of day, the number of deaths and injuries (Figs. 17 and 18) shows a peak occurrence between 5 p.m. and 7 p.m. LST. The Delta Outbreak of 1971 is the main reason for 5 p.m. being the time of peak occurrence. Also, secondary maxima are noted from 7 a.m. to 10 a.m. LST, and from midnight to 1 a.m.

The Severe Plot program (Hart 1993) was used to generate the number of tornado reports. The database for the program, however, uses the verification of *county* warnings. Since severe weather warnings are verified by whether or not a tornado occurred in a warned county—not by specific numbers of reported tornadoes—the number of tornado reports may be exaggerated. This is due to long-track tornadoes moving across county lines, resulting in single tornadoes being logged as separate tornadoes.

Finally, we note that the second worst tornado in U.S. history (possibly *the* worst) occurred in the Jackson CWA on May 7, 1840. Grazulus (1993) states that this tornado tracked across Concordia Parish, Louisiana, into Adams County, Mississippi. The 100-yd-wide tornado caused massive destruction in central and northern Natchez, killing at least 317 and injuring 109. The death toll may have been higher as local newspaper accounts state that some of the local plantation deaths may not have been included at the time (the *Free Trader Newspaper*, Natchez, May 8 and May 15, 1840). Also, some local accounts state that a number of "transients" on river flatboats may not have been included (Grazulus, 1993). According to the *Free Trader* account, "the air was black with whirling eddies of walls, roofs, chimneys, and huge timbers from distant ruins . . . all shot through the air as if thrown from a mighty catapult."

3. Severe Thunderstorm Climatology

Convective High Wind Events

Convective high wind events were defined as those with measured or estimated winds greater than 50 kt,or when damage was reported in association with thunderstorms that was deemed to have been produced by winds greater than 50 kt. As with the overall severe weather climatology, there was a general increase in the number of wind reports through time. The greatest increase was again in the post-verification era. Figures 19 and 20 indicate distinct relative maxima in the 1970s, the early 80s, and the late 80s to early 90s. The overall average number of high wind days per year was 19, but the number increases to 34 days per year in the period after 1980.

Figure 21 shows the primary occurrence of convective wind damage events to be from late February through July, with a secondary seasonal occurrence around November. September and October are typically the quietest months, while April is usually the most active. Figure 22 shows the number of reported high wind events by hour. As with the total distribution of severe weather reports, the highest occurrence of reports was from 1 p.m. through 10 p.m. LST, with the peak around 7 p.m. This coincides, of course, with an afternoon thunderstorm maximum (compare Figs. 22 and 9). The lowest time of occurrence was from 3 a.m. until 9 a.m., with the minimum around 5 a.m.

Hail Events

The National Weather Service also defines a thunderstorm as severe if it contains hail of 0.75 in diameter or greater. For this study, hail is classified using the following:

Hail	0.75 in or greater in diameter
Large Hail	Hail greater than 1.75 in, but less than 2.75 in
Giant Hail	Hail greater than 2.75 in diameter

Since 1955, the number of reports of hail per year (Fig. 23) and the number of hail days (Fig. 24) have steadily increased. One reason for the sharp increase in reports can be attributed to the beginning of an enhanced NWS warning verification program in 1980. Raw data shows that only 20% of the hail reports used in this study were received from 1955-1979, while 80% of the reports were received from 1980-1993. A similar result is seen in the raw data for hail days—34% from 1955-1979 and 66% from 1980-1993.

While thunderstorms are capable of producing hail during any month across the Jackson CWA, the spring months of March, April and May have 64% of the occurrences (Fig. 25), with the peak in April. A much smaller secondary maximum exists in November. Of all hail reports, 37% constitute large hail and only 3% giant hail. Both of these classifications show a similar pattern (Figs. 26 and 27), with a peak in April and a small secondary peak in November. Interestingly, no giant hail has ever been reported during the months of August through October, nor in December.

Hail events also show a diurnal trend, with the peak occurring from 3 p.m. to 9 p.m. LST (Figs. 28, 29, and 30). This corresponds well with peak reports of other severe weather events, both damaging wind and tornadoes.

4. Tropical Cyclones

The Jackson NWSFO no longer has forecast responsibility for the coastal zones. However, landfalling tropical cyclones can still have a significant impact on forecast area in the form of high winds, heavy rains (flash flooding), and tornadoes. The table below shows the history of landfalling tropical storms or hurricanes whose centers have passed into or near the CWA. Figure 31 illustrates the monthly distribution of storms that have passed into the CWA and shows the highest frequency of occurrence to be from August through October. For the period 1900 through 1994, the centers of 27 tropical storms and three hurricanes passed into the new CWA (Dept. of Commerce 1993b).

Tropical Storms / Hurricanes Within CWA Boundary
1900 through 1995

Year	Class	Name	Dates	Path Description
1901	TS	Un-named	Aug 15-16	New Orleans, La to just northwest of Meridian
1905	TS	Un-named	Aug 29-30	Morgan City, LA to Vicksburg to Ashley County
1906	TS	Un-named	Sep 27-28	Gulfport to Tunica
1907	TS	Un-named	Sep 21-22	New Orleans, LA to Meridian
1909	TS	Un-named	Sep 20-21	Baton Rouge, LA to Natchez to Ashley County
1911	TS	Un-named	Aug 12-13	Pensacola, FL to Meridian to Greenwood
1912	TS	Un-named	Jun 13-14	Baton Rouge, LA to Meridian
	TS	Un-named	Sep 14	Pascagoula to Greene County, MS to Meridian
1915	TS	Un-named	Sep 29-30	New Orleans, LA to Jackson
1916	TS	Un-named	Jul 5-7	Gulfport to Jackson to Greenwood
1920	TS	Un-named	Sep 21-22	Morgan City, LA to Monroe
1923	TS	Un-named	Oct 15-16	Morgan City, LA to Natchez to Ashley County
	TS	Un-named	Oct 17	Biloxi to Oxford
1926	TS	Un-named	Aug 26-27	Morgan City, LA to Monroe
1932	TS	Un-named	Sep 1-2	Bayou La Batre, AL to Hattiesburg to Tunica
	TS	Un-named	Oct 15-16	Baton Rouge, LA to Hattiesburg - Laurel
1934	TS	Un-named	Jun 16-17	Grand Isle, LA to Vicksburg to Greenwood
1948	TS	Un-named	Sep 4-5	New Orleans, LA to Scott County to Tupelo
1949	TS	Un-named	Sep 4-5	Vermillion Bay, LA to McComb to Columbus
1955	TS	Brenda	Aug 1-2	New Orleans, LA to Concordia/Catahoula Parishes
1957	TS	Audrey	Jun 27-28	Lake Charles, LA to Monroe to Greenville
1960	TS	Ethyl	Sep 15-16	Gulfport to Hattiesburg - Laurel
1965	H	Betsy	Sep 10	Passed just west of Natchez and Vicksburg
1969	H	Camille	Aug 17-18	Passed from Pass Christian to Memphis, TN
1971	TS	Edith	Sep 16	From Lake Charles, LA to Meridian
1979	TS	Bob	Jul 11	From Slidell, LA to Copiah County
	H	Frederic	Sep 12-13	From Mobile, AL to Meridian then to Columbus
1985	TS	Danny	Aug 15-16	Crossed Northeast Louisiana then to Vicksburg
	TS	Elena	Sep 2	From Biloxi to north of Natchez
1992	TS	Andrew	Aug 26-27	From Morgan City, LA to Natchez to Jackson
1995	TS	Erin	Aug 3	From Mobile, AL to just northwest of Meridian

5. Flash Flooding

In an average year, flash flooding is the leading cause of death nationwide due to weather. Lightning is normally a very close second (Dept. of Commerce 1992). Our research has found that classic flash flood events do not occur on a large scale across the Jackson CWA. However, river water and rain can combine to create havoc for large and small communities, as well as rural and agricultural areas. Many problems result from urban encroachment onto the flood plains of small and large streams. Basically, flooding across the CWA occurs in three forms: (1) river and large stream flooding, (2) backwater flooding, and (3) urban and small stream flooding (poor drainage).

A combination of urban and small stream flooding is the most common cause of critical (flash) flood problems in many communities. Sometimes, residential areas must be evacuated. Low water crossings of roads may become inundated in these situations, and insubstantial bridges may be washed away. Most flash flood warnings issued across the CWA are for these cases, and the Jackson NWSFO Station Duty Manual calls attention to the significance of the hazard.

The general flood season across the CWA is from November through June (the period of greatest rainfall). March and April are the periods of greatest frequency. Local overflows can occur on many streams and rivers on an average of four times a year. The much larger Mississippi River floods about once every two years from upstream runoff (U.S. Dept of Commerce 1982).

6. Conclusion

Overall, no significant changes in year-to-year seasonal variations in severe weather reports were noted over the sample period. The Jackson county warning and forecast area on average has a maximum of severe weather occurrences in the spring (primary peak) and fall (secondary peak), with minima in the winter and summer. Most severe weather reports tend to come in the afternoon and evening hours between 1 p.m. and 10 p.m., with a minimum of reports at 5 a.m.

Over the past 43 years the number of severe weather-related deaths has declined in the Jackson CWA. This is especially true of tornado-related deaths. Prior to 1972, 272 persons died as a result of tornadoes in the CWA. Significant tornado events account for many of those fatalities, such as the Mississippi Delta outbreak in 1971 (118 deaths). Only 54 deaths have been attributed to tornadoes since 1972.

While the number of tornado-related deaths has declined, the overall number of severe weather reports has increased tremendously. The conclusions from this are important. Better detection—through improved technology (radar and satellites), communications, population growth and public education—has no doubt led to increased and more timely reports of severe weather. Increased lead times, improved warnings, and probably better safety precautions have all led to fewer deaths.

7. Acknowledgements

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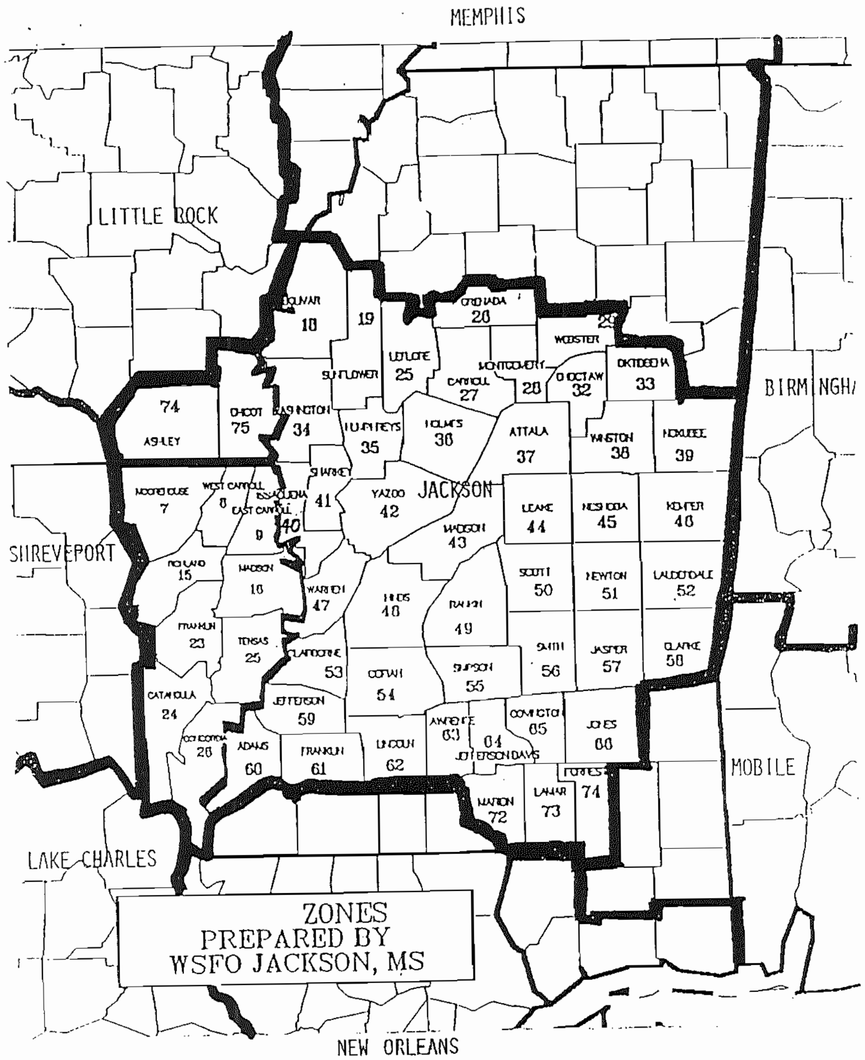
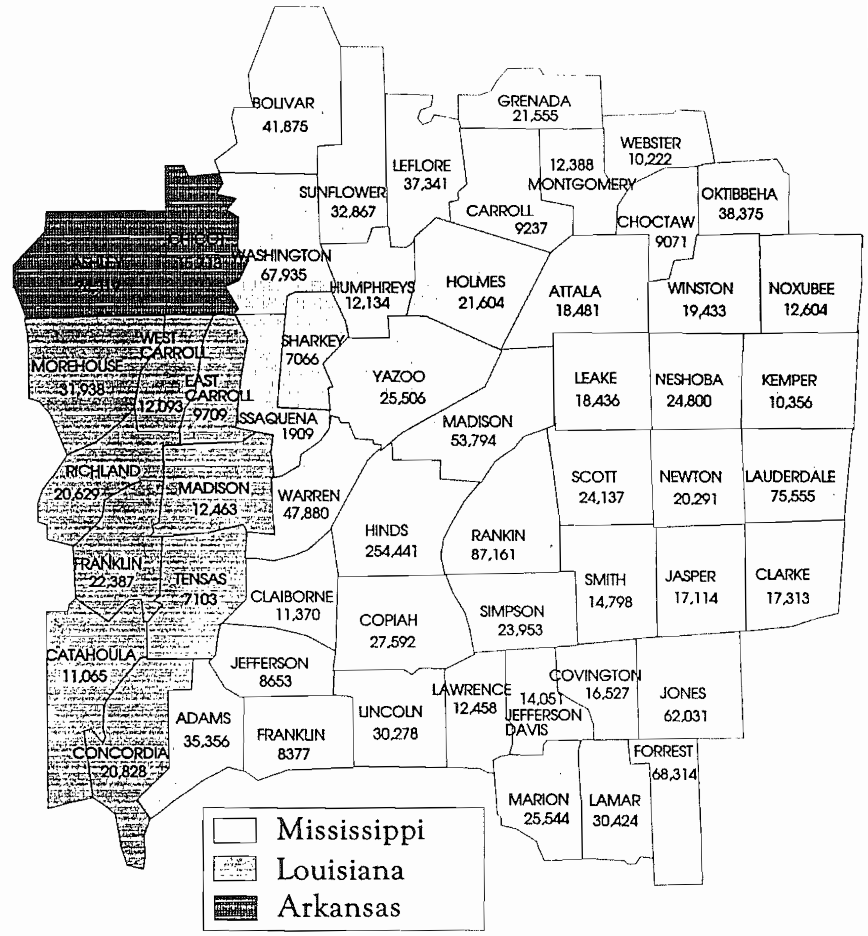


Figure 1

COUNTY WARNING AREA POPULATION
1990



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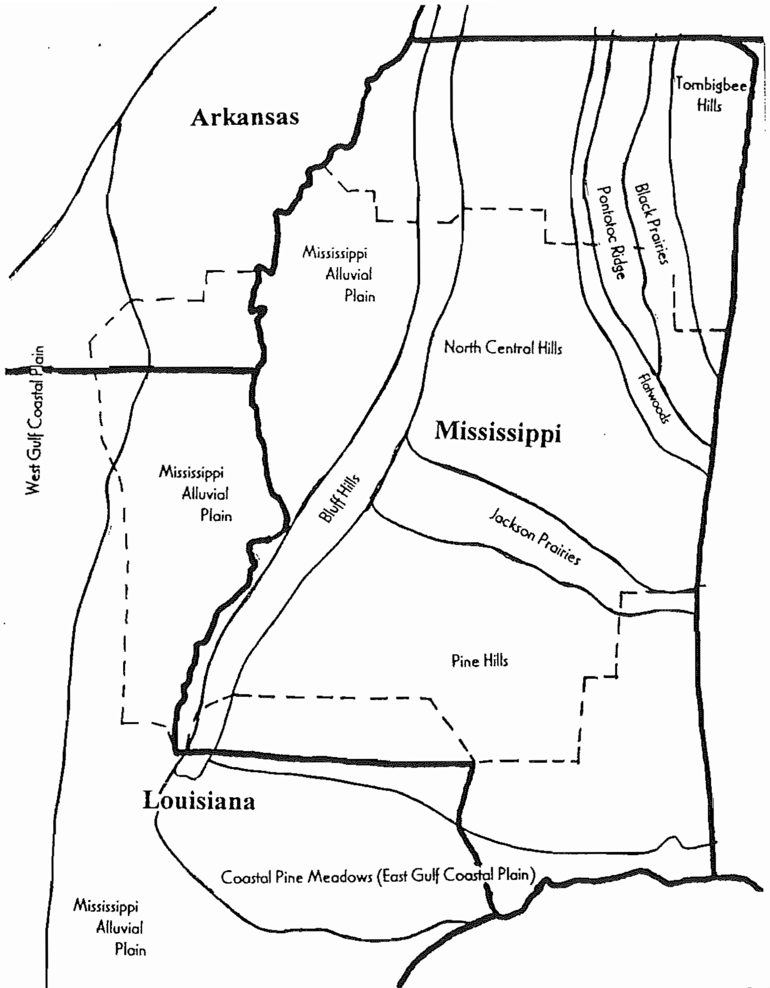


Figure 3

SEVERE WEATHER DAYS

1959 - 1994

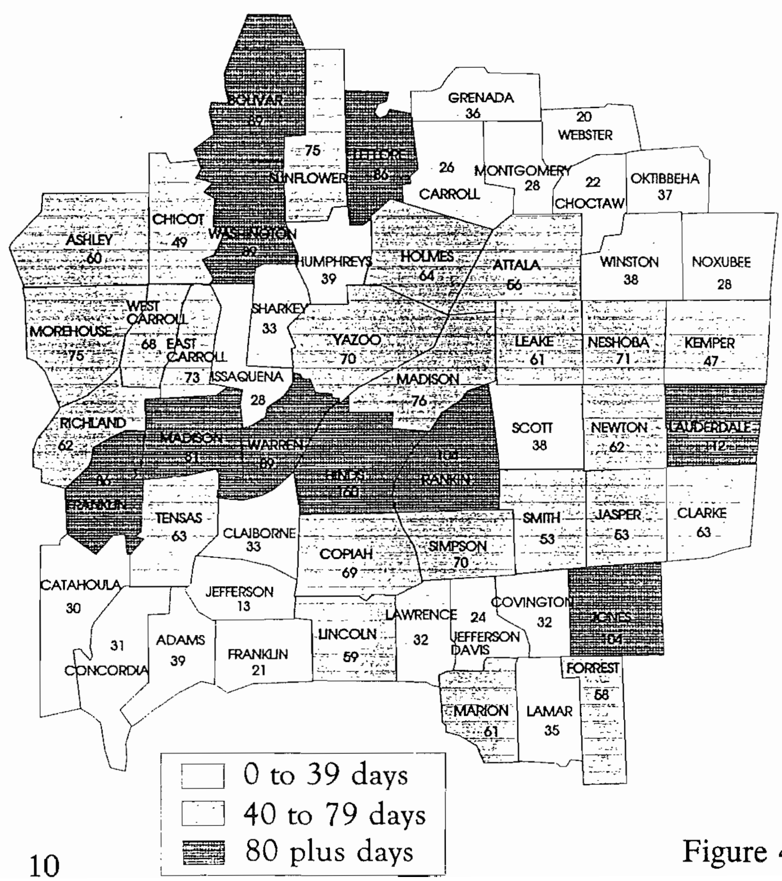


Figure 4

SEVERE WEATHER DAYS

1959 - 1979

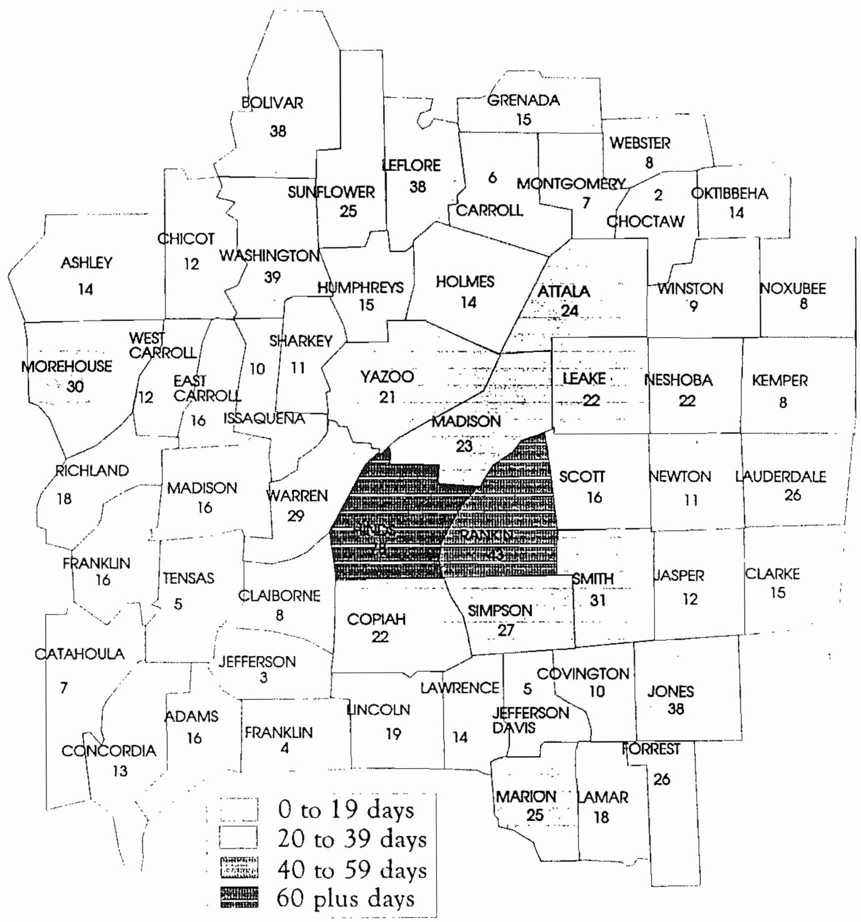
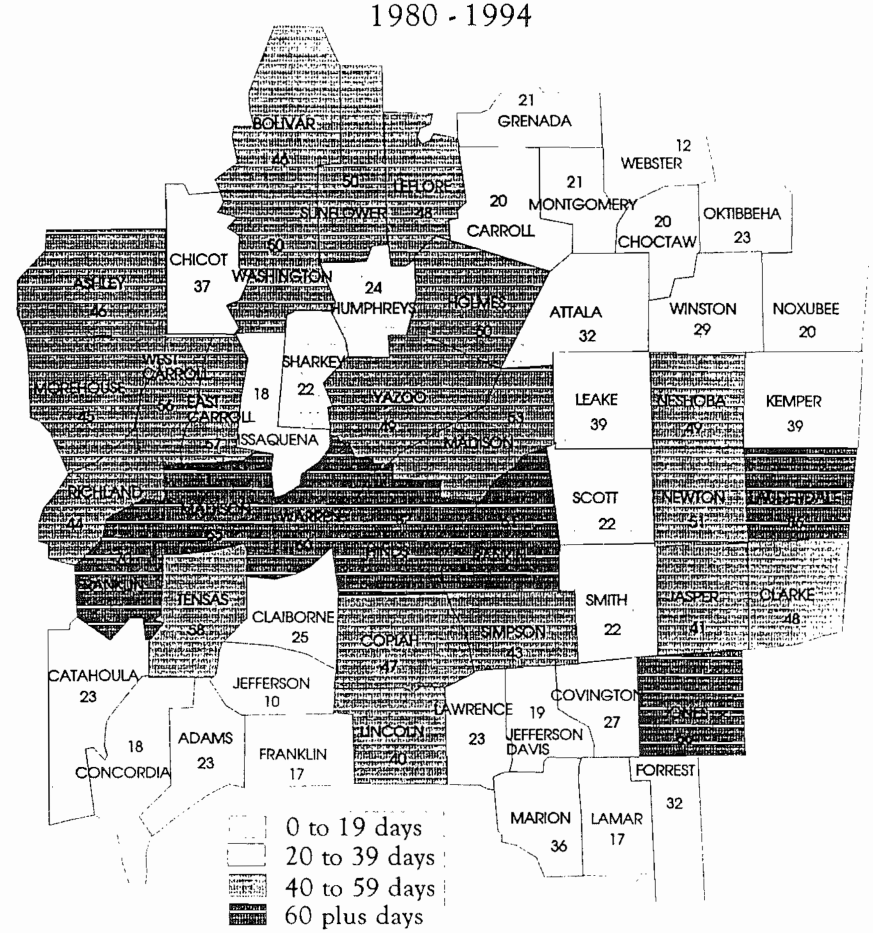


Figure 5

SEVERE WEATHER DAYS

1980 - 1994



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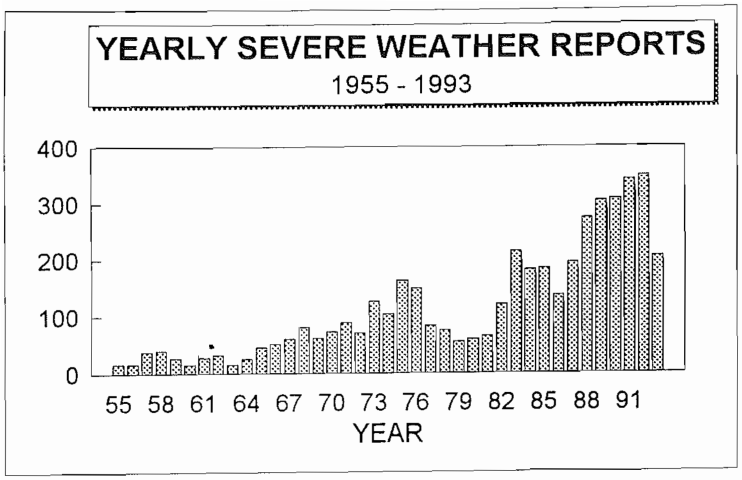

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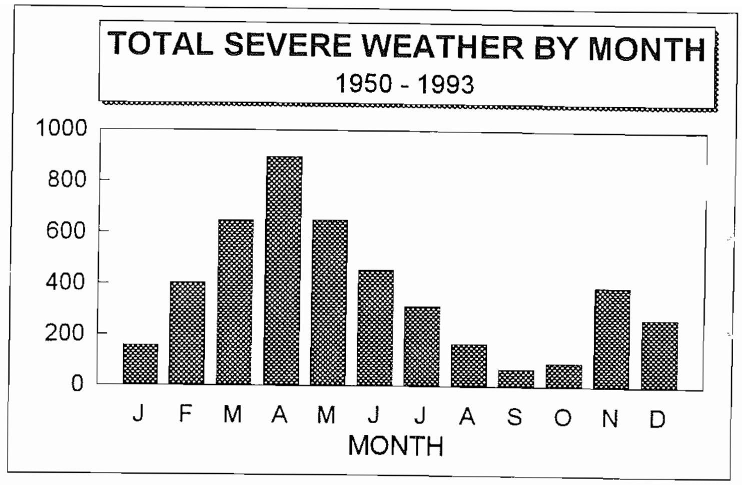

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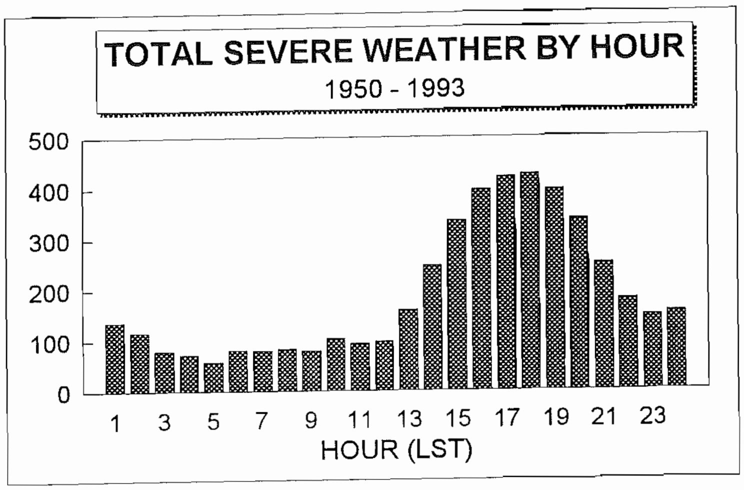

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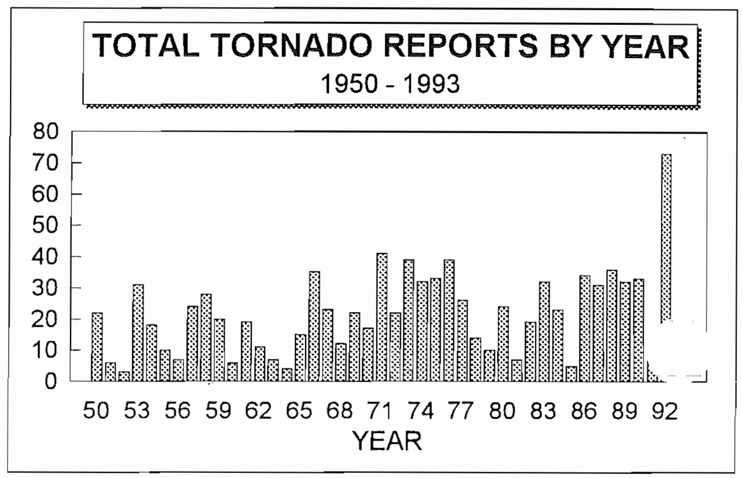

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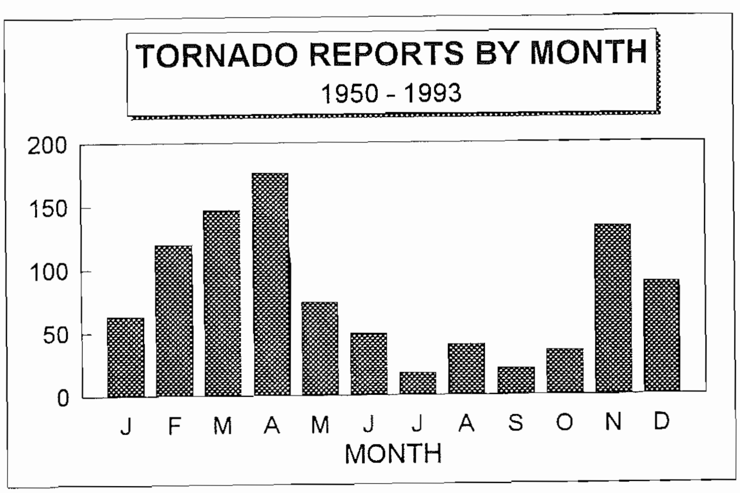

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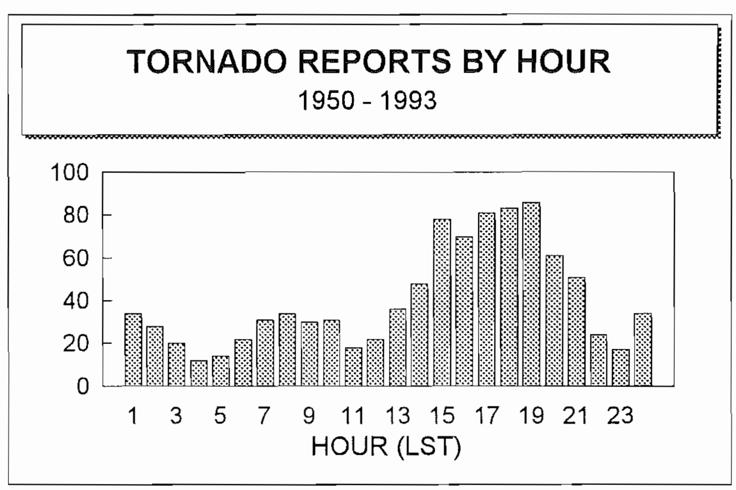

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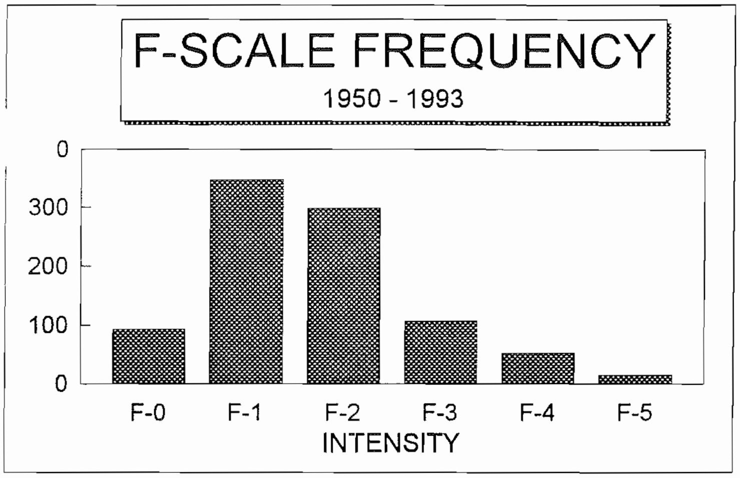

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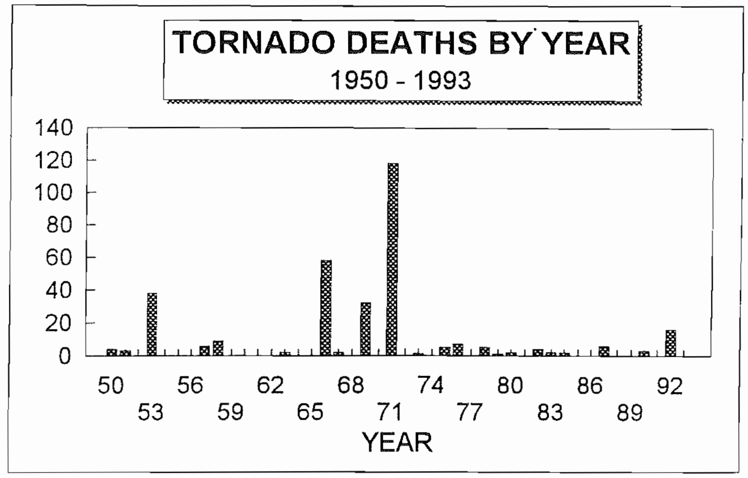

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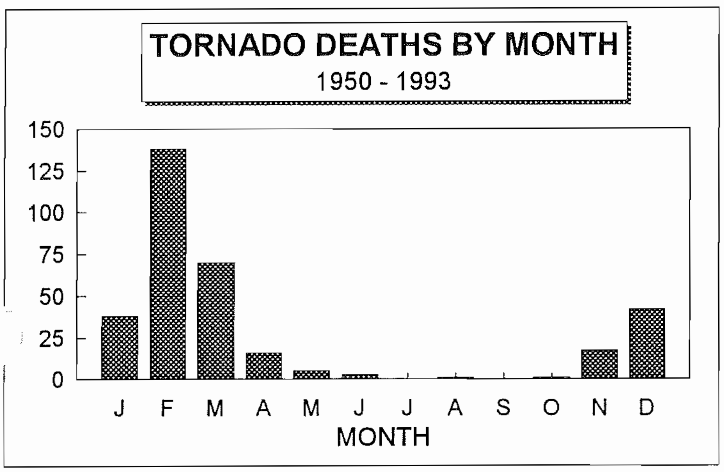

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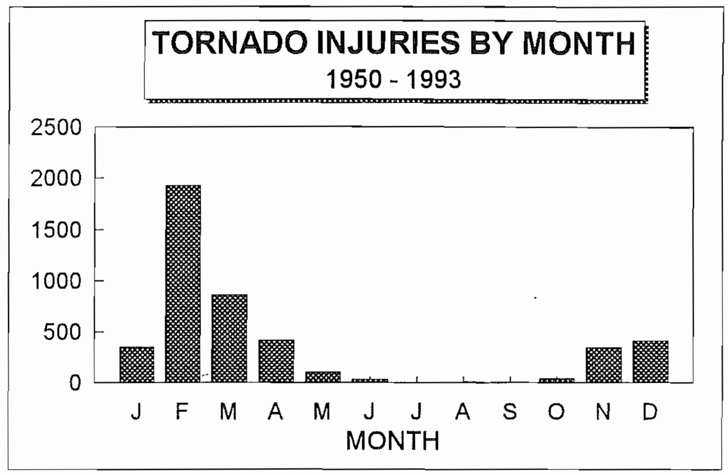

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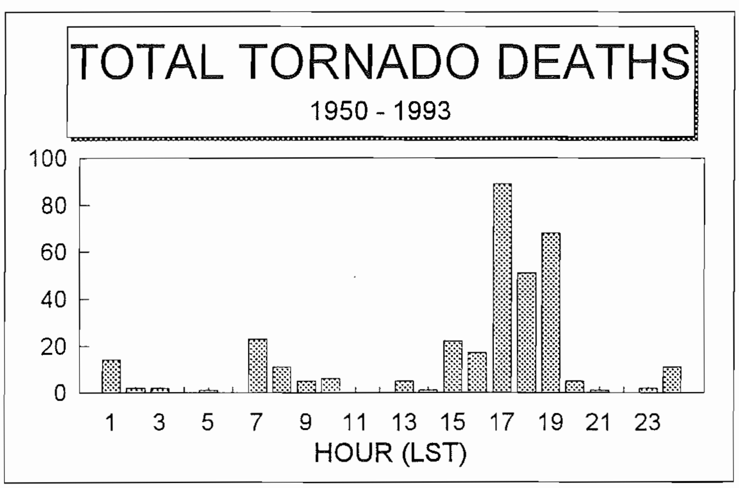

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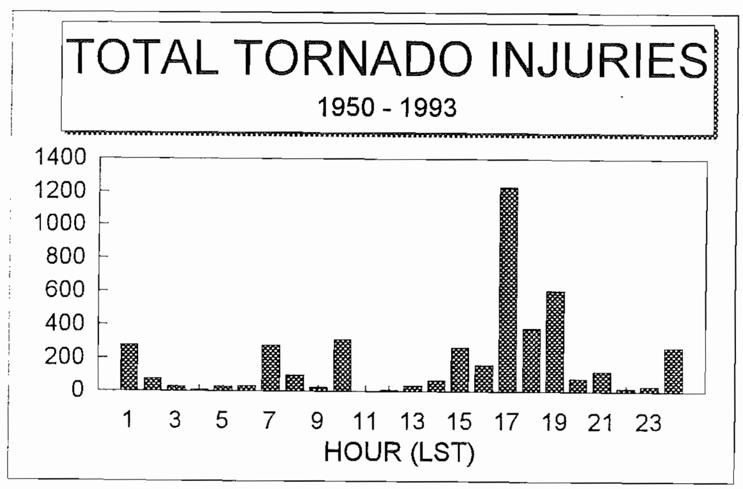

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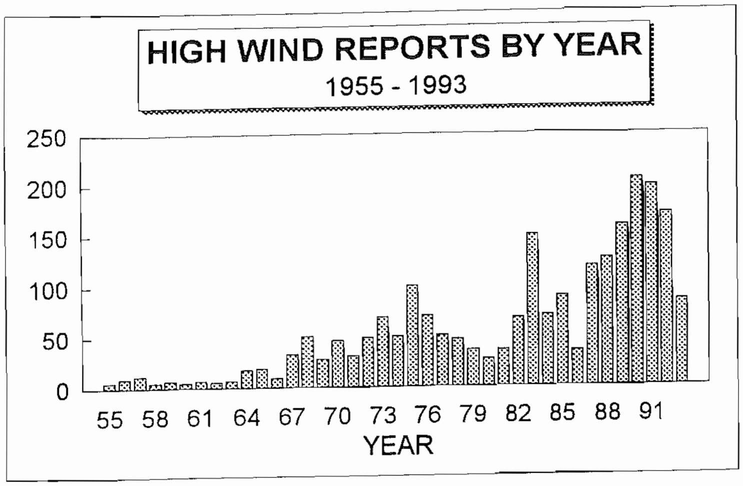

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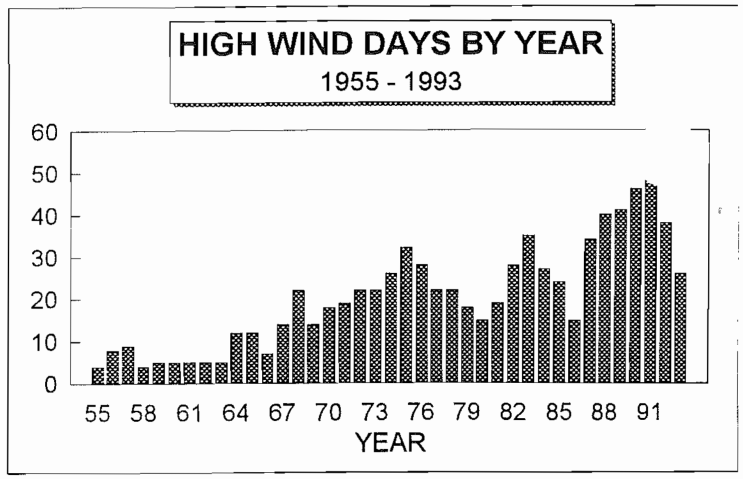

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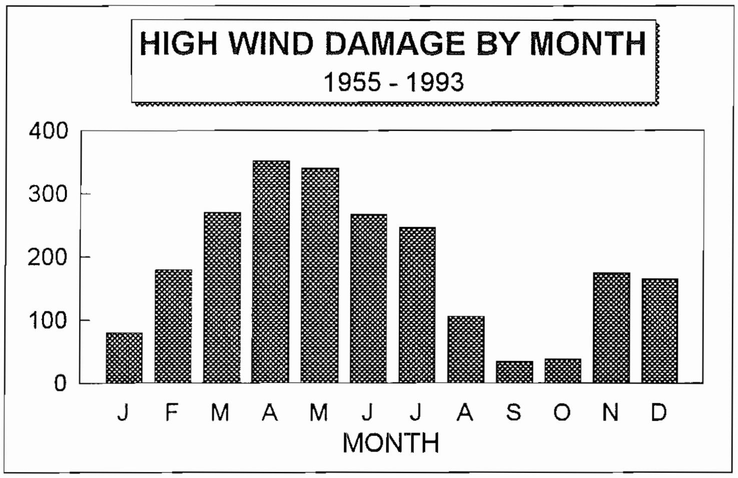

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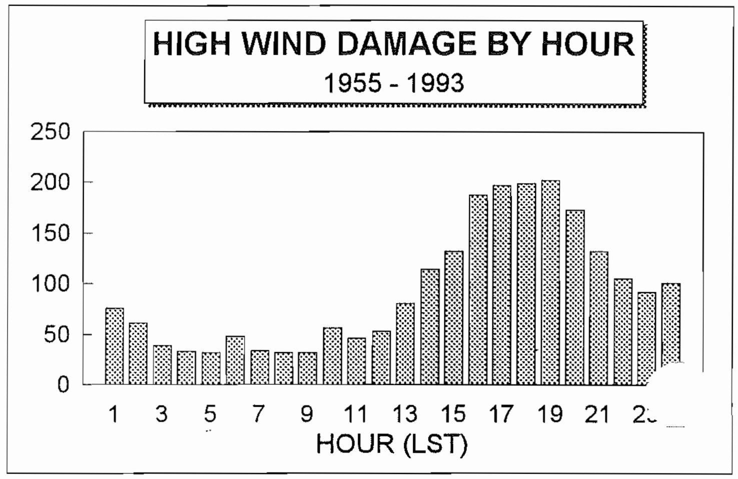

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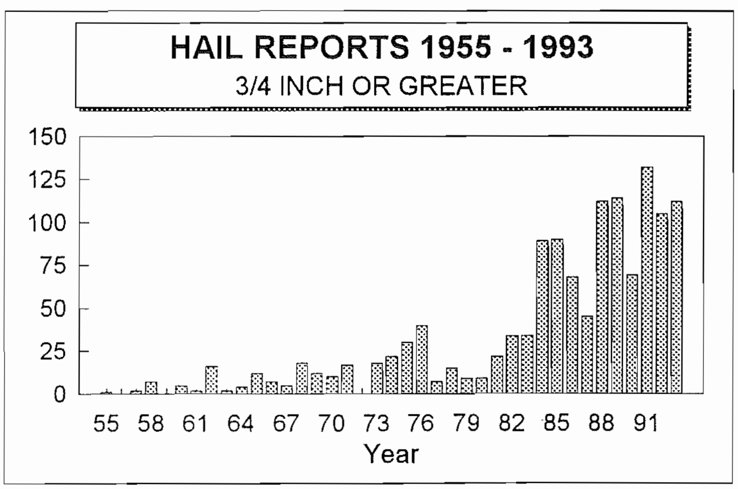

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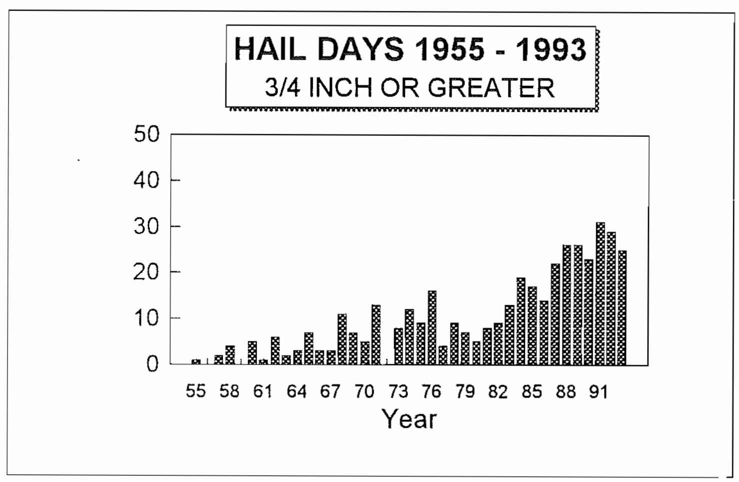

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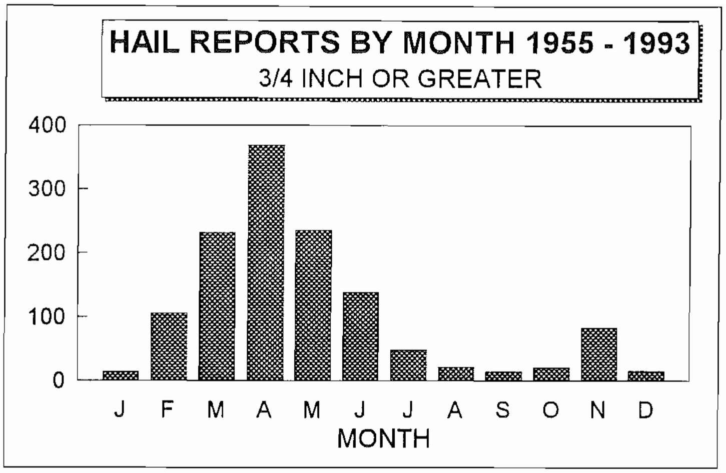

Figure 25

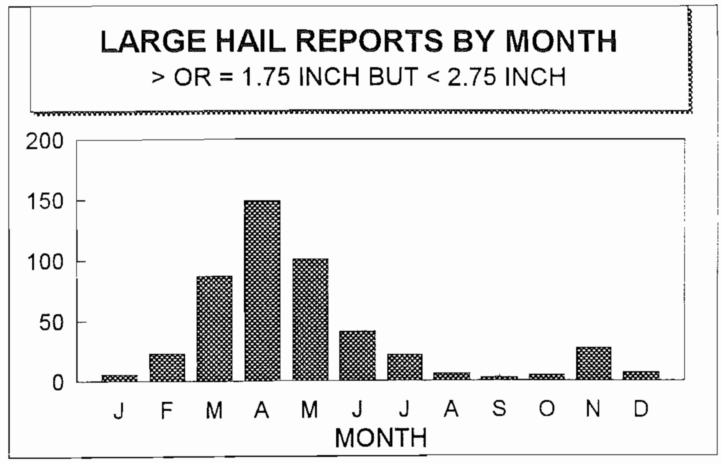

Figure 26

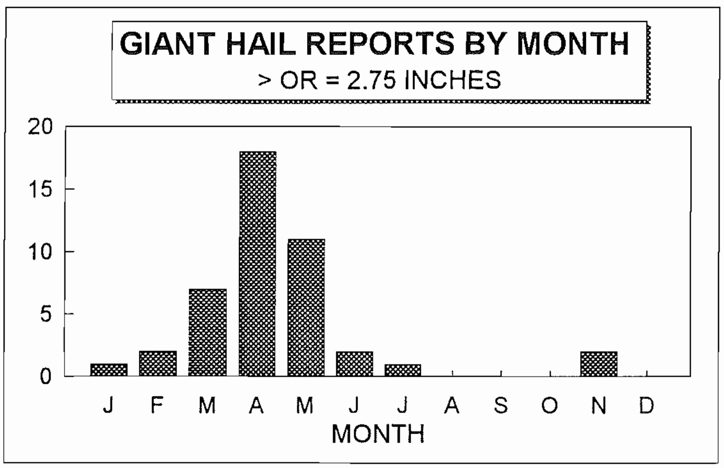

Figure 27

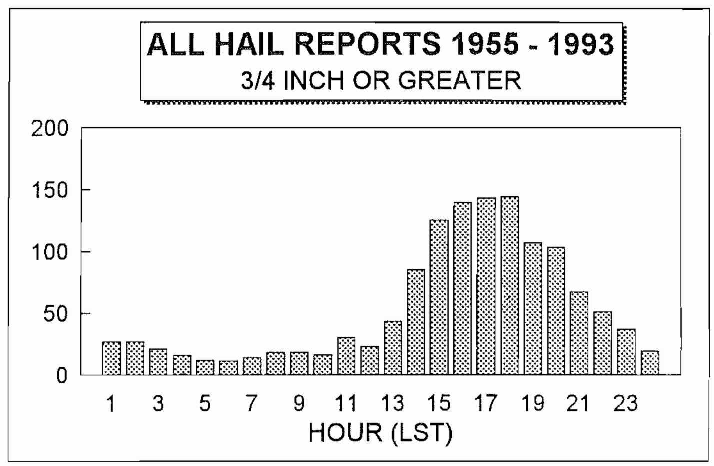

Figure 28

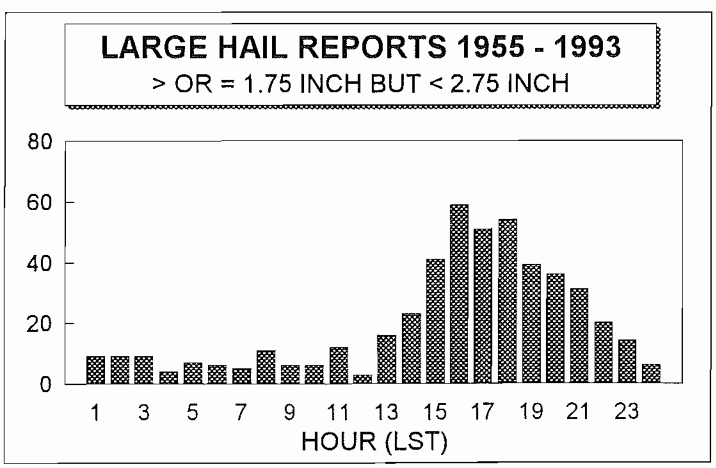

Figure 29

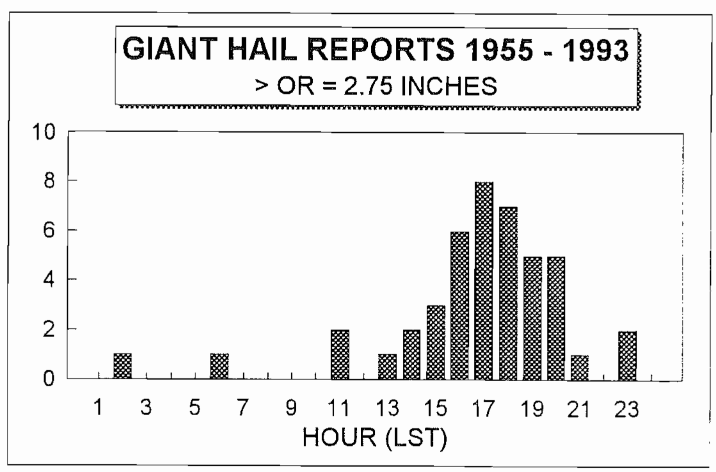

Figure 30

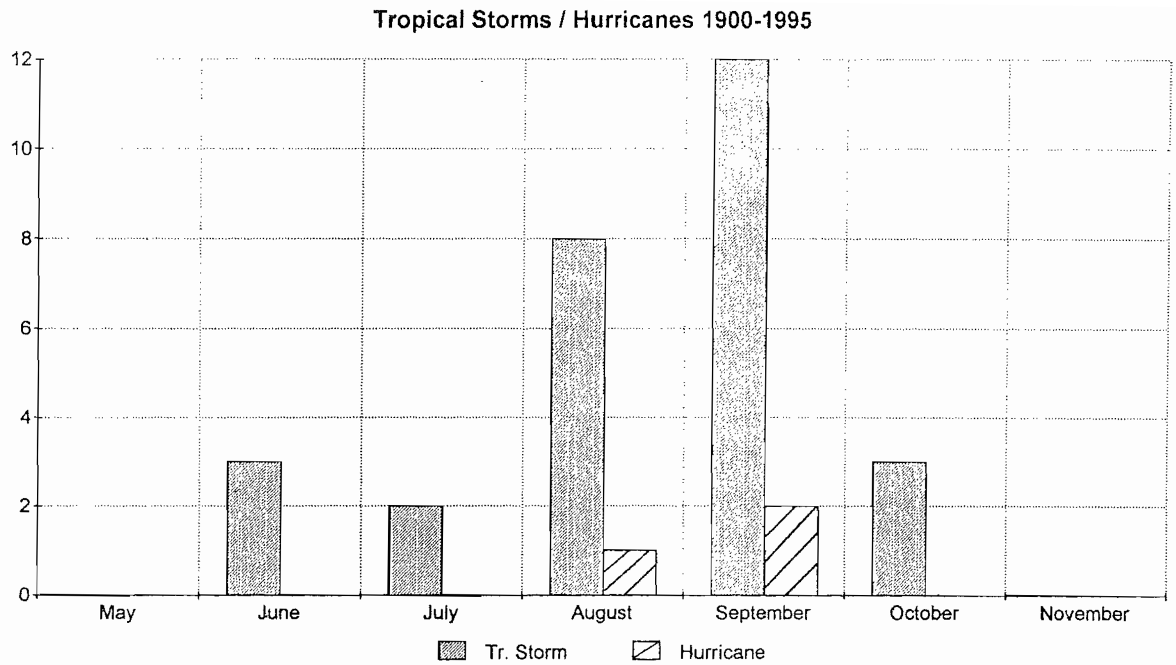
Tropical Storms / Hurricanes 1900-1995
12
10
8
6
4
2
0
May
June
July
August
September
October
November
Tr. Storm
Hurricane

Figure 31